NASA Facts

National Aeronautics and
Space Administration

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Space Infrared Telescope Facility (SIRTF)

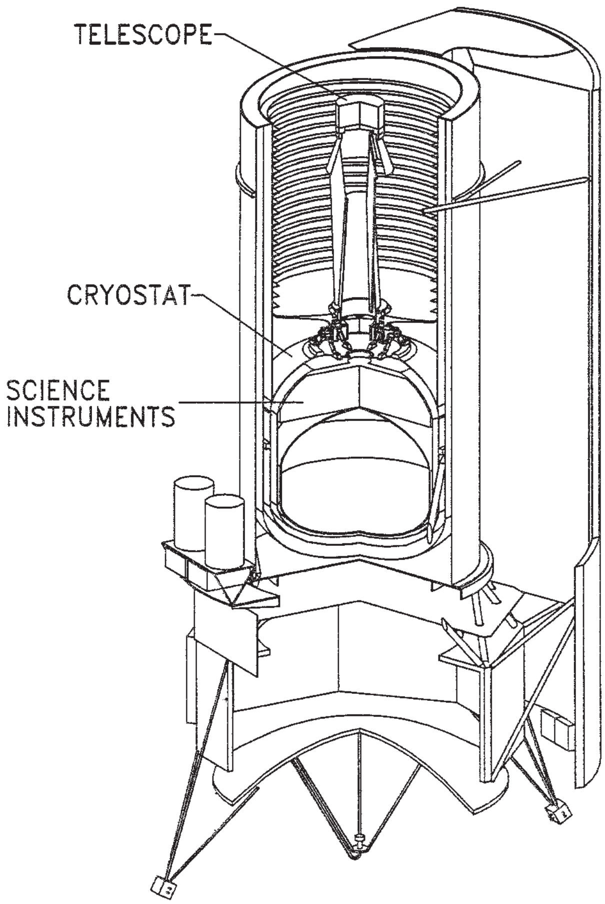
The Space Infrared Telescope Facility (SIRTF), now planned by the National Aeronautics and Space Administration (NASA) for launch as early as 2001, will explore the birth and evolution of the universe and the objects within it with unprecedented sensitivity, viewing phenomena not seen through other astronomical techniques. The SIRTF mission is managed for NASA by the Jet Propulsion Laboratory (JPL), a division of the California Institute of Technology.

Infrared wavelengths, redder than the human eye can see, can be thought of as heat radiation. The colder infrared detectors are, the better they can "see" objects in the sky that glow in the infrared. In space, infrared telescopes are above the warmth of Earth's atmosphere, and can be cooled to very low temperatures, enabling studies of objects that range from far below room temperature to many thousands of degrees.

SIRTF will be the first space observatory to combine such a highly sensitive cryogenically cooled telescope with the imaging and spectroscopic power of a new generation of infrared detector arrays. SIRTF will see through clouds of dust and gas that obscure much of the universe from view. It will sense the infrared radiation, or heat, emitted by objects from the oldest galaxies to forming stars and emerging planetary systems. Scientists expect the observatory to help them discover the answers to important questions about the origin and evolution of the universe, its galaxies and stars, and to seek out stars like the Sun that may hold planets like Earth orbiting about them.

SIRTF's specially designed orbit will completely remove the spacecraft from the heat of the Earth and from the obscuring atmosphere that blocks our view of most of the infrared light from celestial sources. The observatory will see wavelengths of light critical to NASA's quest for an understanding of our origins, allowing astronomers to discover the basic processes underlying the formation of planets and the birth of stars and galaxies.

The National Academy of Sciences designated SIRTF the highest priority major mission for all of



U.S. astronomy in the 1990s. With U.S. technology developments, innovative engineering and streamlined mission planning, SIRTF has undergone radical redesign to meet challenging cost constraints. The result is an affordable yet enormously powerful observatory.

Astronomers will use SIRTF to explore the infrared universe with a depth and precision complementary to that achieved by NASA's other Great Observatories — the Hubble Space Telescope (HST), the Advanced X-ray Astrophysics Facility (AXAF), and the Compton Gamma Ray Observatory (GRO). SIRTF's planned launch for a minimum two-and-a-half-year mission beginning in 2001, would permit overlapping, synergistic observations with companion Great Observatories HST and AXAF.

SIRTF's Key Scientific Questions

How common are planetary systems around other stars?

Recent discoveries of Jupiter-sized planets around other stars have fueled expectations that planetary systems exist around numerous nearby stars. Data from SIRTF will identify the disks of material around other stars that signal the existence of emerging or existing planetary systems. This will provide key information for NASA's Origins program that seeks ultimately to find Earth-like planets elsewhere in our galaxy.

What is the energy source responsible for the most luminous objects in the universe?

Colliding galaxies were found by the trailblazing Infrared Astronomical Satellite (IRAS) of the early 1980s to be among the most luminous objects in the universe, just as bright as quasars. SIRTF studies would be critical in determining the engine that produces these super-energetic objects, whose ages date to 90 percent that of the universe. Such information will shed new light on the early history of the universe.

Where is the "missing mass" of the universe hidden?

Missing "dark matter", which is unseen but makes its presence felt by its gravitational effects on stars and gas, is a persistent puzzle in astrophysics. SIRTF is designed to search for brown dwarfs and giant "superplanets" that may contain this missing mass. Although smaller than stars, these objects are massive compared to planet-size bodies and may account for the vast quantity of unseen material that must exist in our galaxy.

How did galaxies form and evolve in the early universe?

SIRTF will have the capacity to study galaxies at the edge of the universe. These faraway galaxies are so distant that the radiation they emit takes many billions of years to reach Earth and they are receding so rapidly that the radiation is "redshifted" into the infrared. The light from these objects reaching us today reflects events that happened early in the history of the cosmos. By studying them, SIRTF will be able to see scenes from the early universe.

What lies beyond?

A mission optimized for these four themes is broadly applicable to a much wider range of astrophysical investigations. The mix of science to be carried out from SIRTF will be defined close to launch, based upon the latest discoveries and theories from the astronomical community, including those produced by the Infrared Space Observatory launched in 1995 by the European Space Agency. In addition, SIRTF’s great observational capabilities give the mission very high potential for unexpected discoveries.

New Technology, Cost Savings and Partnerships

SIRTF has been recognized as a key element in the NASA astrophysics program for more than a decade. In that time, the mission has been restructured and redefined to be consistent with the new NASA paradigm of faster/better/cheaper.

Technical innovations have played a major role in defining the new SIRTF. Its science focus is sharply defined. The mission implementation uses a unique solar orbit. The Observatory has adopted a new, super-efficient architecture. The science instruments employ state-of-the-art arrays of infrared detectors. Partnerships are being created between the project and industry to streamline and optimize SIRTF’s development, integration test and assembly.

State-of-the-Art Infrared Technology

SIRTF’s three instruments (a camera, spectrograph and imaging photometer) all employ state-of-the-art infrared detector arrays. They represent vast improvements over previous sensors used in space astronomy missions.

❑ A Smithsonian Astrophysics Observatory/Hughes Santa Barbara Research Systems/NASA Ames Research Center team has provided a tenfold improvement in SIRTF’s short-wavelength arrays.

❑ A Cornell University/Rockwell team developed antimony-doped silicon arrays for measuring the redshifts of distant galaxies.

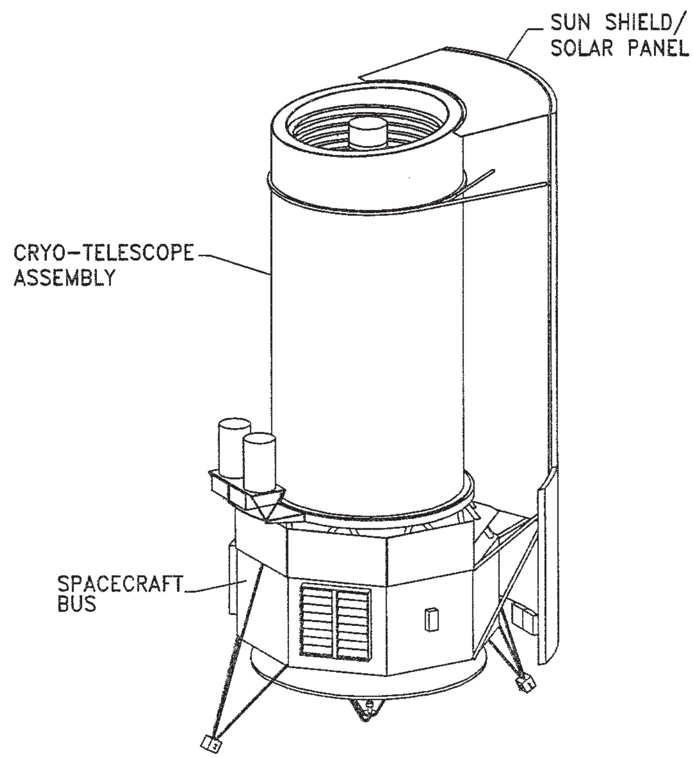
❑ A University of Arizona/Hughes Santa Barbara Research Systems team has produced the first 1,000-element far-infrared array for long-wavelength surveys.

New Lightweight Telescope

SIRTF will use a revolutionary new lightweight telescope fabricated by Hughes Danbury Optical Systems. The telescope is made of entirely of beryllium and weighs less than 50 kilograms (110 pounds). The mirror's diameter is 85 centimeters (33 inches). This high-quality, space-qualified telescope holds great promise not only for SIRTF but also for astronomical and Earth remote-sensing instruments both on the ground and in space. The entire spacecraft weighs 850 kilograms (1,870 pounds), is 4 meters (13 feet) tall and 2-1/4 meters (7.4 feet) in diameter.

Innovative Telescope Cooling System

SIRTF's architecture substantially differs from previous infrared missions. The telescope will be launched warm and cooled in orbit largely by radiating its heat to space. This approach reduces the amount of cryogen needed to cool the large-aperture telescope (0.85-meter or 2.7-feet in diameter), allowing launch on a Delta launch vehicle. SIRTF requires just 250 liters (66 gallons) of helium for 2-1/2 years versus the 500 liters (132 gallons) used for cooling by SIRTF's predecessor, the 10-month-long IRAS mis-



sion. The helium is stored on the spacecraft in a dewar at a temperature of 1.4 degrees above absolute zero.

A Unique Orbit

A solar orbit in which SIRTF will trail Earth as it goes around the Sun has been adopted for this mission. This eliminates the viewing restrictions caused by Earth occultations, removes the spacecraft from the heat emitted from Earth's atmosphere, and simplifies operations by having the observatory in a slowly changing location that accommodates flexible telecommunications scheduling. Data received through NASA's Deep Space Network from SIRTF will be processed and disseminated to the science community at the JPL/Caltech Infrared Processing and Analysis Center located at the Caltech campus.

NASA-Industry Partnership

The observatory will be built by industry based on a design developed jointly with JPL and the science community. Once selected by a competitive process, industry members will join the SIRTF team and work to meet project commitments. The project must be completed within a fixed budget and will require an unprecedented degree of cooperation. Clear responsibilities will be established to minimize redundant or overlapping efforts. The result is expected to demonstrate how, with the new paradigm of faster/better/cheaper, NASA can continue to conduct significant scientific missions using state-of-the-art technology with uncompromised performance.

More information on the SIRTF mission is available from the project's home page at http://sirtf.jpl.nasa.gov/sirtf/home.html .

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